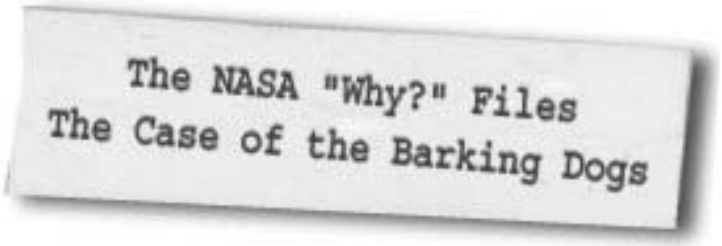


Segment 4

The tree house detectives are getting very close to solving the case of the barking dogs. They use deductive reasoning to figure out what is not causing the dogs to bark. They also review what they have learned about high-frequency sounds and how sound travels through different mediums. They decide to do an internet search on the different kinds of things that make high-frequency sounds. The search leads them to a bat curator at a local museum who helps them discover an animal who uses high-frequency sounds. They learn about echolocation and its usefulness to bats. The children think there might be a correlation to the dogs' barking and electronic devices being used by the neighbors. They e-mail the neighbors who responded to their first e-mail to see if there is a connection. In the meantime, Dr. D suggests that he present a "show and tell" to their class on how low- and high-frequency sounds travel. After returning to the tree house, the detectives are really surprised at the many responses to their e-mails! The children use the matrix to sort through the e-mails and analyze their data. They were right! There is a connection. KSNN reports that Mr. Big T (the traveling Gum Sonic Toothbrush salesman) has been selling faulty electronic toothbrushes. The children have finally put it all together! Case solved. One visit to Dr. D's lab, a quick demonstration of the faulty electronic toothbrush, and Bernie the dog's reaction, prove the toothbrushes were producing a frequency that caused dogs to bark. They further deduce that the dogs that were barking inside the house were causing the dogs outside to bark. The tree house detectives review how they used the scientific method to solve the case of the barking dogs.

Objectives

The students will be able to

• learn how a bat uses high-frequency sound.

• learn more about electronic devises that make high-frequency sound.

• discover how high- and low-frequency sound waves travel.

• use a matrix to analyze and sort data.

Vocabulary

devices - a mechanical contrivance

echolocation - the system of acoustic detection that allows bats and other mammals to orient themselves by emitting ultrasounds that bounce off other objects

electric dog repeller - an electronic device that makes a high-frequency sound that makes dogs leave a desired area

eliminate - to leave out of consideration, omit

internet search - using the Internet to find information

navigate - to steer or direct

possibilities - things that may or may not happen

respond - to react

Video Component (15 min)

Before Viewing

1. Summarize briefly what took place in segment 3.
2. Review the scientific method.
3. Introduce the concept of "surfing the web" (internet searches).
4. Using the worksheet provided, have the students conduct a Web Search Scavenger Hunt (computer with internet capabilities required).
5. Have students brainstorm a list of possible items that could make high-frequency sounds. This could be a web search activity.
6. Based on previous segments and knowledge of sound, have students predict what they think is causing the dogs to bark.

After Viewing the Video

1. Continue to guide students in modifying and adding to the Methods of Science Board created in segment I (p. 14).
2. Discuss the students' reactions to the solution of the problem and the predictions they made previously.

Resources

Web Sites

Uses for Sound Waves

A web site that explores how sonar helps paleontologists look for dinosaurs in New Mexico. http://www.ornl.gov/ornl94/blasting.html

Tulane orthopedists are using low-intensity sonic ultrasound waves to get patients with fractured bones out of plaster faster. http://www.som.tulane.edu/TMCinfo/monitor/nov95.Casting.html

Sonic Boom

A primer describing how a sonic boom is created, including 3D images. http://www.galcit.caltech.edu/~brad/boom/boomprimer.html

A NASA Fact Sheet about sonic booms. http://www.dfrc.nasa.gov/PAO/PAIS/HTML/FS-016-DFRC.html

General Sound Web Sites

A web site for students to explore sounds, which includes activities, discussions, sound cards and more. http://www.sci.mus.mn.us/sound/nocss/top.html

"The Quivering Bundles that Let Us Hear" is a starting point for understanding how people hear sound. http://www.hhmi.org/senses/c/c110.htm

Percussion Instruments

Listen to a percussion band at this site! http://members.nbci.com/LouPanic/home.htm

Sonar (Sound Navigation and Ranging)
Learn how sonar is used to hunt for the Loch Ness Monster. http://www.pbs.org/wgbh/nova/lochness/

Learn how United States Geological Survey scientists use Terrestrial Remote Sensing to map the ocean floor with sonar. http://TerraWeb.wr.usgs.gov/

A database of sounds including whales, dolphins, and navies from around the world. http://hp.vector.co.jp/authors/VA012709/divonsub.rm

A gallery of sounds and images ranging from sonar databases to libraries of sound clips. http://vision.dai.ed.ac.uk/ashley/Sonar/gal.html#mm

Bats

A Science Inquiry Unit
http://avocado.dade.k12.fl.us/projects/bats/index.html

Bat Cave of St. Clair in Jamaica
http://www.torstar.com/rom/batcave/index.html

Bat Cave of Australia http://moneyraptor.com/bats.htm

Books

Leen, Nina: *Images of Sound.* W. W. Norton & Company, December 1977. ISBN 0393088006

Kenda, Margaret, and Williams, Phyllis, and Robinson, Tim: *Science Wizardry for Kids*, September 1992, ISBN 0812047664

Careers

Bat Curator
Computer Programmer
Sales person
Television Reporter
Cameraman
Behavioral Scientist
City Planner
Sonar Technician
Submariner
Geologist

Activities and Worksheets

In the Guide

Vocabulary Crossword Puzzle 55
Students can use this worksheet to create their own crossword puzzle using the key science vocabulary words from the program.

Owl and Mouse Game 56
A game designed to give students an experience with echolocation as they hunt for "prey."

Mapping the Ocean Floor 57
An activity that simulates sonar techniques used to map the ocean floor.

On the Web

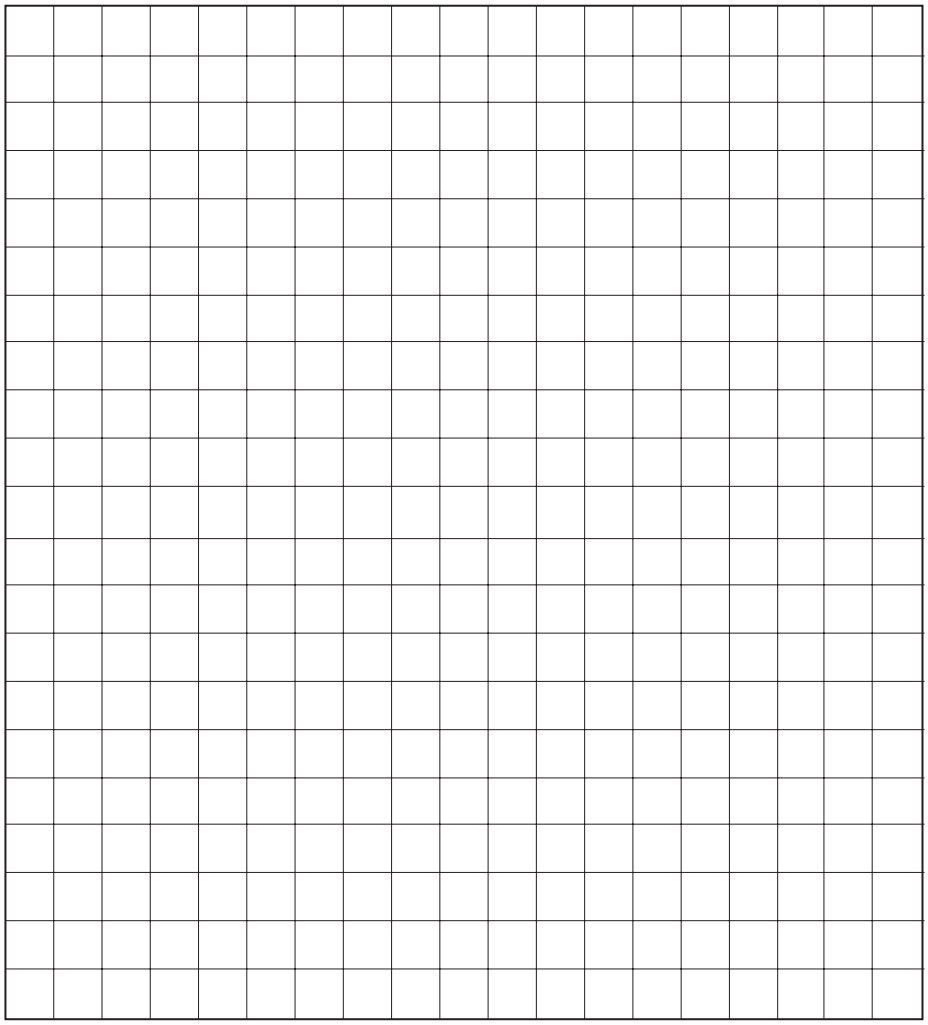
You can find the following activities on the Web at http://whyfiles.larc.nasa.gov.

A Scavenger Hunt, "Surfing the Net"
An activity that gives students an opportunity to perform a web search.

Bats in the Belfry, a Bat Diorama
Students will choose a species of bat and create a diorama depicting the bat's environment, habitat, and lifestyle.

Hot Topics of Sound
A list of topics for students of all grade levels to research and learn more about sound

Vocabulary Crossword Puzzle



Create your own crossword puzzle using the key science vocabulary words from the program.

Vocabulary

devices
echolocation
electric dog repeller
eliminate
internet search
navigate
possibilities
responded
Add your own:

_____
_____
_____
_____
_____
_____

Across

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Down

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Owl and Mouse Game Echolation Activity

Purpose

To give the students an experience with echolocation.

Materials

2 clickers
2 blindfolds

This activity will show how some nocturnal animals such as bats and owls and underwater predators, such as dolphins, use echolocation to hunt their prey. Due to the darkness they incur while hunting, these animals rely on sound. They send out a high-frequency signal, which echoes and enables them to determine the identity of the object and to calculate the distance of the object. This "echolocation" allows animals to hunt in the darkest of environments. This activity will simulate the process.

Procedure

1. Have students stand in a circle and hold hands to create the area or boundary for the game.
2. Choose two students to stand in the middle of the circle with their backs to each other. Explain that one of the students will be the owl (predator) and the other will be the mouse (prey).
3. Tell the students that they will be blindfolded and give them each a clicker. Explain that the owl is to click the clicker, and when it clicks, the mouse will click his clicker in return. The owl will use the sound of the mouse's clicker to locate him. However, the mouse can move away from the owl as long as he stays within the perimeters of the circle. If the owl or mouse bumps into the students standing in the circle, the students should gently guide them back to the center of the circle. Students standing should be quiet.
4. Blindfold both students and hand each a clicker.
5. Let the game begin.
6. Continue until the owl finds or captures the mouse. When the mouse is captured, he should squeak loudly to inform the owl that he has caught his prey.
7. Repeat with other students taking turns as the owl and mouse.

Conclusion

1. Why was it difficult for the owl to find the mouse?
2. What could make it less difficult?
3. How would the fastness of the clicks affect the owl's ability to locate the mouse?
4. Explain how echolocation helps predators to find their prey.

Mapping the Ocean Floor (Sonar)

Purpose

To simulate the mapping of the ocean floor with sonar techniques.

Using a new type of sonar called Sea Beam, scientists are making better and more detailed maps of the ocean floor. Sonar is the use of sound waves to detect ocean bottom features. From the bottom of a ship, a sound wave is sent toward the ocean floor. As it bounces off the ocean floor, it returns an echo, which is picked up by a receiving device. The computer on the ship calculates the distance to the bottom by using the speed of sound in water and the time it takes for the sound to be reflected. As the ship sweeps the ocean floor going back and forth across the sea floor, it gathers depth readings that are overlapped to make a detail map. These maps help to locate underwater canyons where fish can be found, to find oil-bearing deposits, and for study by oceanographers.

Materials (per group)

- Shoe box with lid
- Clay or plaster-of-paris (enough to cover the bottom of the shoe box)
- Ruler
- Pencil
- Skewer or long straight stick
- Graphing Chart—Profile of Ocean Floor
- Highlighter/marker

Procedure

Advanced Teacher Prep

1. Prepare the shoe boxes for each group by lining the bottom with clay or plaster of paris. Create shapes with the clay such as mountains, valleys, abyssal plains, and any other desired ocean floor feature. If using clay, let it stand for several days to dry and harden.
2. Draw or tape a grid on the lid of the shoe box by using centimeter squares.
3. At the intersection of each grid mark, poke a hole through the lid so that the skewer can be inserted.
4. Place the lid on the shoe box. It is now ready for use.
5. Before beginning the activity, review with the students how to graph. Go over graphing chart noting the labels of axes, increments of numbers, key, and scale.
6. You may wish to demonstrate a few points.

Mapping the Sea Floor

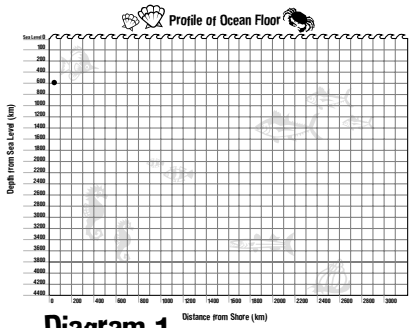


Diagram 1

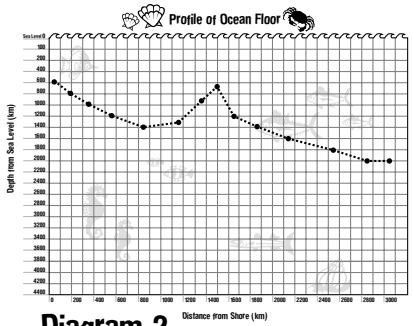


Diagram 2

1. Students will begin by choosing a horizontal (longest) line from the grid on the lid of the box and highlighting that line. This will be the line that they will use to "sound" along to create a cross section of their ocean floor.
2. The edge of the box will represent the shoreline. The students will begin from one edge of the box and insert the skewer perpendicular to the bottom of the box in the first hole along their sounding line. When the skewer stops, lightly mark (with a pencil) the bottom part of the skewer that is remaining above the lid.
3. Withdraw the skewer and measure in centimeters the distance from the end of the skewer that was inserted to the line that you drew.
4. Using the scale (2 cm=200 km), calculate the depth of your first sounding.
5. Plot this point on your graphing chart (p. 58), noting that you are 1 cm from the shoreline. For example: If you are taking your first sounding, you are 1 cm away from the edge of the box. This reading will calculate to 100 km by the scale. If you measure the depth as 3 cm, you will have a depth of 600 km (3 X 200). Now you are ready to plot the point. Go over the bottom to find your distance from shore of 100 km and then go up to your depth of 600 km and mark that point. See diagram 1.
6. Continue to take soundings at each hole along your sounding line.
7. As you plot your points, connect the points to give you a visual profile of the ocean floor. See diagram 2.
8. Discuss the ocean floor profile and determine features, if possible.

Mapping the Ocean Floor